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Date: December 30, 2004

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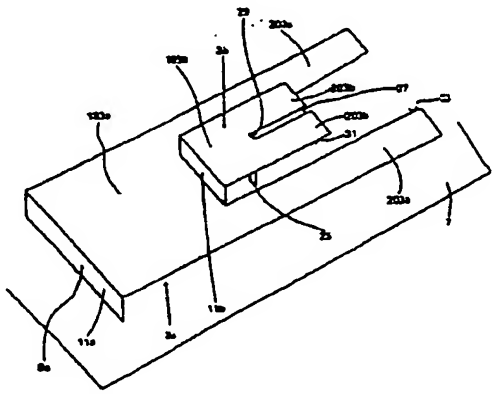
As printed

(54) Title: LOW-HEIGHT DUAL OR MULTI-BAND ANTENNA, IN PARTICULAR FOR MOTOR VEHICLES

(54) Bezeichnung: NIEDRIG BAUENDE DUAL- ODER MULTIBANDANTENNE, INSBESONDERE FÜR KRAFTFAHRZEUGE



(57) Abstract: The invention relates to an improved, low-height dual or multi-band antenna comprising surface transmitters (3a, 3b), whose size varies in accordance with the frequency band to be transmitted. Said antenna is configured from a smaller surface transmitter that is located on top of a larger surface transmitter. The antenna is characterised by the following improved features: the dual or multi-band antenna is essentially configured as a one-piece punched and bent metal part; as a one-piece component, said antenna consists of at least two surface transmitters (3a, 3b), which are electrically connected via a short-circuit (11b); and at least the lowest surface transmitter for transmission in a lower frequency band and/or at least a surface transmitter (3a) that is lower than the surface transmitter for transmission in the highest frequency band have transmitter wings (203a) lying adjacent to their transmitter surface (103a). When the antenna is viewed from above, the respective surface transmitter (3b) for transmission in a higher frequency band lies between the wings of said lower frequency band transmitters.

(57) Zusammenfassung: Eine verbesserte, niedrig bauende Dual- oder Multibandantenne mit Flächenstrahlern (3a, 3b), die in der Grösse in Abhängigkeit des zu übertragenden Frequenzbandes variieren und von einem grösseren Flächenstrahler nach oben hin zu einem kleineren Flächenstrahler aufeinander aufbauend ausgebildet ist, zeichnet sich durch

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For an explanation of the two-letter codes and the other abbreviations, reference is made to the explanations ("Guidance Notes on Codes and Abbreviations") at the beginning of each regular edition of the PCT Gazette.

folgende verbesserte Merkmale aus: die Dual- oder Multibandantenne ist im Wesentlichen als einteiliges Stanz-Biege-Metallteil gebildet, und die Antenne umfasst dazu als einstöckiges Bauteil zumindest zwei Flächenstrahler (3a, 3b), die über einen dazwischen wirksamen Kurzschluss (11b) elektrisch verbunden sind, und zumindest der unterste Flächenstrahler für die Übertragung in einem niedrigeren Frequenzband und/oder zumindest die gegenüber einem Flächenstrahler für die Übertragung in einem höchsten Frequenzband gegenüber niedrigeren Flächenstrahler (3a) weisen benachbart zu ihrer Strahlerfläche (103a) Strahlerflügel (203a) auf, zwischen denen in Draufsicht auf die Antenne der jeweilige Flächenstrahler (3b) für die Übertragung in einem dazu höheren Frequenzband zu liegen kommt.

Low-height dual or multiband antenna, in particular for motor vehicles

The invention relates to a low-height, dual or multiband antenna, in particular for motor vehicles, as claimed in the precharacterizing clause of claim 1.

The 900 MHz or the so-called 1800 MHz band is used for communication purposes, particularly in German and European mobile radio networks. The so-called 1900 MHz band is used for transmission, particularly in the USA. UMTS networks, which will be the next to appear, are designed to use the 2000 and 2100 MHz band ranges.

Low-height antennas are desirable in particular in the motor vehicle field and are intended to have electrical characteristics which are as good as possible, that is to say in particular a wide bandwidth, a good omnidirectional characteristic and a compact physical form.

Dual-band flat antennas have already been proposed on this basis and are also referred to, inter alia, as "stacked dual-frequency-microstripe" PIF antennas.

One such antenna which is known from the prior art has a flat antenna element which is parallel to a metallic base surface or base plate and is short-circuited on one of its longitudinal faces to the metallic base plate by means of a short circuit which runs at right angles to the flat antenna element and to the base plate. The length and width, and the size, of the flat antenna element are, by way of example, matched to the lowest frequency to be transmitted, for example to the 900 MHz band.

A flat antenna element based on a comparable principle is constructed on this basis, which is intended for transmission of a wider frequency band range, and is correspondingly physically smaller. It is seated with its longitudinal and transverse extent, which are shorter overall, with a further flat antenna element approximately centrally, in a plan view, on the physically larger flat antenna element located underneath it, to be precise likewise in a position parallel to it. On one of its longitudinal faces, preferably on the same longitudinal face as the flat antenna element for the lowest frequency band range, it is connected via a short circuit to the flat antenna element located underneath it. The short-circuiting element is preferably likewise once again aligned at right angles to the two flat antenna elements.

The feed is provided via a feed line which preferably runs at right angles to the flat antenna elements and is routed such that it runs essentially at right angles upward as far as the lower face of the topmost flat antenna element from a feed point, for example a matching network, in the area of the base plate, from which the feed point is isolated. For this purpose, an appropriate passage opening is provided in the flat antenna element located underneath it, in order to route the feed line as far as the topmost flat antenna element.

Although antennas such as these have in fact been proven in practice, the object of the present invention is to provide an improved flat antenna element whose production and assembly are considerably simpler than those for previous solutions. According to the invention, the object is achieved by the features specified in claim 1. Advantageous refinements of the invention are specified in the dependent claims.

The low-height dual or multiband antenna according to the invention is distinguished by its major parts being formed from a complete, integral stamped and bent part.

In other words, at least two flat antenna elements for transmission in two frequency bands as well as a short circuit which acts between them are produced and formed from a single stamped sheet-metal part.

In one preferred development of the invention, the corresponding short circuit for connection of the flat antenna element which is intended for the lowest frequency band range (that is to say that flat antenna element which is provided adjacent to the metallic base plate) is also a component of the entire integral stamped and bent part, that is to say it is a common component with the integral flat antenna.

A further preferred embodiment even provides for the feed line, which runs essentially at right angles to the flat antenna elements, likewise to be in the form of a stamped and bent part, to be precise as a part of the entire stamped and bent part.

The entire design can be cascaded a number of times, so that not only two but also at least three flat antenna elements are formed, which are of different sizes, are each arranged one above the other and run essentially parallel to one another, in order that the compact antenna can also transmit and receive, for example, as a multiband antenna in three band ranges.

Finally, it has also been shown that the dual or multiband antenna may have flat antenna elements which are not necessarily in each case formed at different heights to one another but at the same height, with the short circuit between two flat antenna elements in this case then likewise being arranged such that it runs at the same height level.

The flat antenna elements can essentially be provided with parallel and vertical cut edges and bending edges in a plan view. However, it is just as possible for the stamped edges, which in each case point outwards, of the higher flat elements for transmission in the higher frequency band range to be designed, for example, such that they run diverging slightly outwards from their short-circuit links toward their free end, or such that they converge inward, or to have obliquely running end edge areas in particular at their free end. The stamped edges of the lower-level flat elements can likewise be designed such that they run obliquely, in which case the stamped edges on the outside and inside need not necessarily run parallel.

Another preferred development of the invention furthermore makes it possible to provide for the antenna vanes to be lengthened downwards by a further bend.

In addition, the short-circuit connections need not be formed over the entire width of the respective flat element, but may be shorter than the adjacent transverse extent of the respective flat element.

The invention will be explained in more detail in the following text with reference to drawings in which, in detail:

Figure 1: shows a first perspective view of a first dual-band antenna;

Figure 2: shows another perspective illustration of the dual-band antenna illustrated in Figure 1;

Figure 3: shows a corresponding rearward side view of the flat antenna illustrated in

Figures 1 and 2;

Figure 4: shows a corresponding plan view of the flat antenna shown in Figures 1 to 3;

Figure 5: shows a plan view of a metallic blank plate (metal sheet) on which the stamping and bending lines for production of an antenna in Figures 1 to 4 are shown;

Figure 6: shows an exemplary embodiment of a corresponding flat antenna, modified from that shown in Figure 1;

Figure 7: shows a plan view of the exemplary embodiment shown in Figure 6;

Figure 8: shows a perspective illustration of another modified exemplary embodiment of a flat antenna;

Figure 9: shows a plan view of the illustration shown in Figure 8;

Figure 10: shows a perspective illustration of another modified exemplary embodiment;

Figure 11: shows a further exemplary embodiment of a dual-band antenna with antenna surfaces at the same height;

Figure 12: shows a perspective illustration of a further exemplary embodiment with antenna vanes which have been lengthened downwards;

Figure 13: shows a rearward side view of the

illustration shown in Figure 12;

Figure 14: shows a perspective illustration of a further exemplary embodiment of a triband antenna; and

Figure 15: shows a side view of the exemplary embodiment shown in Figure 14.

Figures 1 to 4 show a first exemplary embodiment of a low-height compact dual-band antenna according to the invention, which comprises two flat antenna elements 3a and 3b which are arranged parallel to one another. An antenna element such as this is normally provided with a larger metallic surface or base plate 7, that is to say it is connected to it, or a corresponding antenna is, for example, when used on a motor vehicle, fitted at an appropriate point on the sheet-metal bodywork of the vehicle, which is then used as the metallic opposing surface or base surface.

The lower flat element or the lower flat antenna element 3a is tuned for transmission in a lower or low frequency band, for example in the 900 MHz band range. The physically smaller flat antenna element 3b which is constructed above this is, for example, tuned for transmission in the region of the 1800 MHz band range.

The upper flat antenna element 3b is connected on its narrower boundary face or edge 9b, which is located on the left in Figure 1, via a short circuit 11b to the physically larger flat antenna element 3a located underneath it, with the short circuit 11b in the illustrated exemplary embodiment having a width which corresponds to the width of the upper flat antenna element 3b.

The lower flat antenna element 3a is likewise equipped

on its narrower boundary face 9a, which is located on the left, with a vertical short-circuiting surface 11a, via which an electrical connection is normally produced to the electrical base surface or base plate 7 that has been mentioned.

Finally, the upper and the lower flat antenna elements are each equipped such that a part of the respective flat antenna element comprises a closed metal surface section 130a or 130b, to which two antenna vanes 203a and 203b, respectively, which are offset in the transverse direction of the antenna element, are then connected on the respective opposite face to the short circuit 11a or 11b.

In the illustrated exemplary embodiment, the entire antenna that is shown in Figure 1 is produced from a single stamped and bent part, with the exception of the base plate 7. In this context, Figure 5 shows a metallic blank metal sheet in which the corresponding stamping lines 19 are shown by dashed-dotted lines, with the bending edge 20 being shown by a dotted line. The flat antenna element 3b for the respective higher frequency band range can then be positioned higher than and parallel to the flat antenna element 3a located underneath it by means of the stamping and cutting process and by subsequently bending along the bending edges 21'a and 21'b, as can be seen from Figures 3a and 3b. The bending process in this case results in the short circuits 11a and 11b being positioned at right angles to the plane of the flat antenna elements.

The plan view of the blank sheet-metal part shown in Figure 5 in this case shows that, in this exemplary embodiment, only the material area identified by x need be cut out and removed during the stamping process. The remaining parts are just stamped and/or folded and bent on the corresponding lines in order then to produce the

dual-band antenna illustrated in Figures 1 to 4.

Finally, a feed line 25 is also required, which is preferably provided at right angles to the plane of the flat antenna elements and is routed from underneath up to the lower face of the flat antenna element 3b above it. In the illustrated exemplary embodiment, this feed line 25 is likewise produced as a stamped and bent part, for which purpose the uppermost flat antenna element 3b has a recess 27 in the form of a slot, to be precise extending from a bending edge 29 which is formed at the left of the end of the recess 27 which is in the form of a slot, thus making it possible to bend a narrow metal strip at right angles downward in order to form the feed line 25 that has been mentioned.

In the exemplary embodiment shown in Figures 1 to 4, the blank material, which is in the form of a plate, is thus used virtually completely, since the flat antenna element which is located between the outer side edges 31 of the upper flat antenna element 3b and the inner side edges 33 of the flat antenna element located underneath it is formed just by means of a stamping or cutting line 19 without having to cut out the material. In the exemplary embodiment shown in Figures 6 and 7, in contrast, a respective short circuit 11a or 11b is made narrower in the transverse direction of the flat antenna elements, so that corresponding material areas have to be stamped out of a blank metal plate while carrying out the stamping and bending process.

Furthermore, the front ends of the antenna vanes 203a and 203b are not provided at their free end with end or cut edges 35 which run at right angles to the longitudinal extent of the antenna vanes, but with end or cut edges 35 which run toward one another obliquely from the outside inward, that is to say they converge.

In the exemplary embodiment shown in Figures 8 and 9, the outer cut edges 31 of the respective higher flat antenna element converge from the short-circuit face toward the free end, and in this case are parallel to the correspondingly converging inner cut edges 33 of the lower flat antenna element 3a. This results in antenna vanes 203b which run to a point, at least for the higher flat antenna element 3b. The antenna vanes 203a of the lower flat antenna element have a width and extent which increase towards their free end. The outer end or cut edge can likewise be designed such that it converges again, in which case the front end tips of the antenna vanes 203a of the lower flat antenna element can then touch one another, or virtually touch one another.

In the exemplary embodiment shown in Figure 10, the piece of feed line, which is likewise produced as a stamped or bent part, is likewise formed from the top downwards as an increasingly narrower metal strip, that is to say as a metal strip with stamped edges 39 which run toward one another, converge and are on opposite sides. Conversely, the short circuit 11a has a trapezoidal shape running from the bottom upwards, at least with respect to the flat antenna element for the lower frequency band range. Finally, the exemplary embodiment illustrated in Figure 11 shows that the antenna surfaces as well as the antenna vanes for the various frequency band ranges may also be arranged at the same height level, that is to say arranged in an O-shape or in the form of a fork, so that, in this exemplary embodiment as well, the short circuit 11b which connects the two flat antenna elements 11b and 11a is located in an arrangement at the same height.

A multiband antenna can also be designed in a corresponding manner to the explained exemplary embodiment, specifically by adding a third flat antenna

element, for example, to the corresponding cascading of the two flat antenna elements as explained in the drawings, which third flat antenna element is physically smaller and is formed in a corresponding repetitive manner on the second flat antenna element. In this case as well, the complete antenna formed in this way may be produced as a single stamped and bent part, that is to say it may be integral.

The following text refers to the exemplary embodiment shown in Figures 12 and 13. In this exemplary embodiment, the antenna element vanes 203a of the lowermost flat antenna element are provided with antenna vane sections 203a' which have been lengthened downwards, thus resulting in the advantage that the antenna vanes 203a can be shortened overall in comparison to other exemplary embodiments and, at the same time, are mechanically more robust. In the illustrated exemplary embodiment, the corresponding antenna vane sections 203a' are in this case formed with bent metal sections, which project vertically downward, on the outer edge of the antenna vanes.

If specified appropriately, antenna vane sections such as these may also alternatively or additionally be provided on an antenna vane 203b on a flat antenna element 3b for transmission in a higher frequency band.

Figures 14 and 15 illustrate a corresponding antenna type, which is suitable for transmission and reception in three bands which are offset with respect to one another. The corresponding design of the flat antenna element 3b in this exemplary embodiment is effectively cascaded once again, in comparison to the previous exemplary embodiments, by the addition of a physically smaller flat antenna element 3c located above it, which likewise once again has corresponding antenna element vanes 303a. The connection to the antenna element 3b

located underneath it is likewise made via a corresponding short circuit 11c. The feed is provided via a feed line 25, which leads to the uppermost flat antenna element 3c.

The antennas which have been explained are so-called PIF antennas, that is to say so-called "planar inverted F antennas". In this case, it is known that the characteristics of the respective antenna can be influenced in the case of antennas such as these by the configuration and the location of the feed point and of the short circuits. The characteristics of the antennas can thus be individually matched to the influences of the respective vehicle bodywork and the respective installation location by the configuration and the location of the feed point and of the short circuits. In this case, the short circuits, for example the short circuits 11a and 11b, are generally each located on the narrow face of the antenna arrangement, which is preferably basically longitudinally symmetrical (that is to say symmetrical with respect to a vertical central longitudinal plane). The feed point for the antenna is preferably provided on this longitudinal line of symmetry or longitudinal plane of symmetry of the antenna. The antenna impedance, which should normally be 50 Ohms for car radio antennas, can also be matched by the position of the feed point and its distance from the short circuit.

Claims:

1. A low-height dual or multiband antenna having the following features:

- at least two flat antenna elements (3a, 3b) are provided for operation in two frequency bands which are offset with respect to one another,
- the two flat antenna elements (3a, 3b) are aligned parallel, or at least approximately parallel, to one another,
- the size of the at least two flat antenna elements (3a, 3b) is tuned to the frequency bands to be transmitted,
- the size of the at least two flat antenna elements (3a, 3b) decreases from bottom to top,
- the flat antenna element (3b) is in each case formed on the flat antenna element (3a) for transmission in a higher frequency band range, and the flat antenna element (3a) is intended for transmission in a frequency band range which is lower than this,
- the dual or multiband antenna formed in this way is arranged or can be positioned on a metallic base surface or base plate (7),
- the flat antenna elements (3a, 3b) have a short circuit (11a, 11b) on one face, preferably on a narrow face (9a, 9b) aligned in the same direction, such that one flat antenna element (3b) for transmission in a higher frequency band range is short-circuited via the short circuit (11b) to the flat antenna element (3a) for transmission in a lower frequency band than this, and the flat antenna element (3a) for transmission in the lowest frequency band range is connected or can be connected via a short circuit (11a) to the metallic base surface or base plate (7),

characterized by the following further features:

- the dual or multiband antenna is essentially in the form of an integral stamped and bent metal part, and

- for this purpose, the antenna has, as an integral component, at least two flat antenna elements (3a, 3b) which are electrically connected via a short circuit (11b) which acts between them, and
- at least the lowermost flat antenna element (3a) for transmission in the lowest frequency band and/or at least a relatively lower flat antenna element (3a, 3b) for transmission in a frequency band which is lower than an upper frequency band has or have adjacent to its or their antenna element surface (103a, 103b) antenna element vanes (203a, 203b) between which the respective flat antenna element (3b, 3c) for transmission in a frequency band which is higher than this comes to rest in a plan view of the antenna.

2. The antenna as claimed in claim 1, **characterized** in that a feed line (25) which runs from underneath to the lower face of the flat antenna element (3b) which is arranged at the top is, furthermore, likewise in the form of a stamped and bent part which is integrally connected to the remaining parts of the antenna formed in this way.

3. The antenna as claimed in claim 1 or 2, **characterized** in that the flat antenna element (3a) which is arranged at the bottom is provided with a short circuit (11a) which forms a part of the antenna and is connected via a bending line (21a) to the antenna element surfaces (103a) of the flat antenna element (103a).

4. The antenna as claimed in one of claims 1 to 3, **characterized** in that a recess (27) which is in the form of a slot is incorporated in the flat antenna element (3b) arranged at the top, to be precise forming a feed line 25, which is curved downward over a bending line, essentially at right angles to the plane of the

flat antenna element (3b).

5. The antenna as claimed in one of claims 1 to 4, **characterized** in that the end edges (35) of the antenna vanes (203a, 203b) run at right angles to the longitudinal edges of the antenna vane.

6. The antenna as claimed in one of claims 1 to 4, **characterized** in that the end edges (35) of the antenna vanes (203a, 203b) are aligned such that they converge from the outer edges toward the center or diverge outwards from the outer edges.

7. The antenna as claimed in one of claims 1 to 6, **characterized** in that those side edges (31) which point outward of the antenna vanes (203b) of the antenna elements (3b) for higher frequencies run from their face which is provided with a short circuit (11b) such that they converge toward their free end or diverge outwards.

8. The antenna as claimed in one of claims 1 to 7, **characterized** in that those stamped edges (33) which point inward of the antenna vanes (203a) of the antenna elements (3a) which are provided for the lower transmission ranges run from their short-circuit face such that they converge toward their free end or diverge outward.

9. The antenna as claimed in one of claims 1 to 8, **characterized** in that the short circuits (11a, 11b) have a rectangular shape and preferably extend over the entire width of the associated antenna element (3a, 3b).

10. The antenna as claimed in one of claims 1 to 8, **characterized** in that the short circuits (11a, 11b) are shorter than the width of the antenna elements (3a,

3b).

11. The antenna as claimed in claim 10, **characterized** in that the short circuits (11a, 11b) have a triangular or trapezoidal shape.

12. The antenna as claimed in one of claims 1 to 11, **characterized** in that the antenna vanes (203a, 203b) of the flat antenna elements (3a, 3b) are arranged at different height levels, with in each case one flat antenna element for transmission in a higher frequency band range being arranged above one for transmission in a frequency band range which is lower than this.

13. The antenna as claimed in one of claims 1 to 11, **characterized** in that at least two flat antenna elements (3a, 3b) are arranged with their antenna vanes (203a, 203b) at the same height level.

14. The antenna as claimed in one of claims 1 to 13, **characterized** in that the antenna element vanes (203a, 203b) are preferably provided on their boundary edge which points outward with antenna vane sections (203a', 203b') which are preferably aligned such that they point downward.

15. The antenna as claimed in one of claims 1 to 14, **characterized** in that the antenna is in the form of a triband antenna and, cascaded with respect to it, has a third flat antenna element (3c) which has at least a similar shape to that of the other two flat antenna elements (3a, 3b) and is matched for transmission in the highest frequency band range.

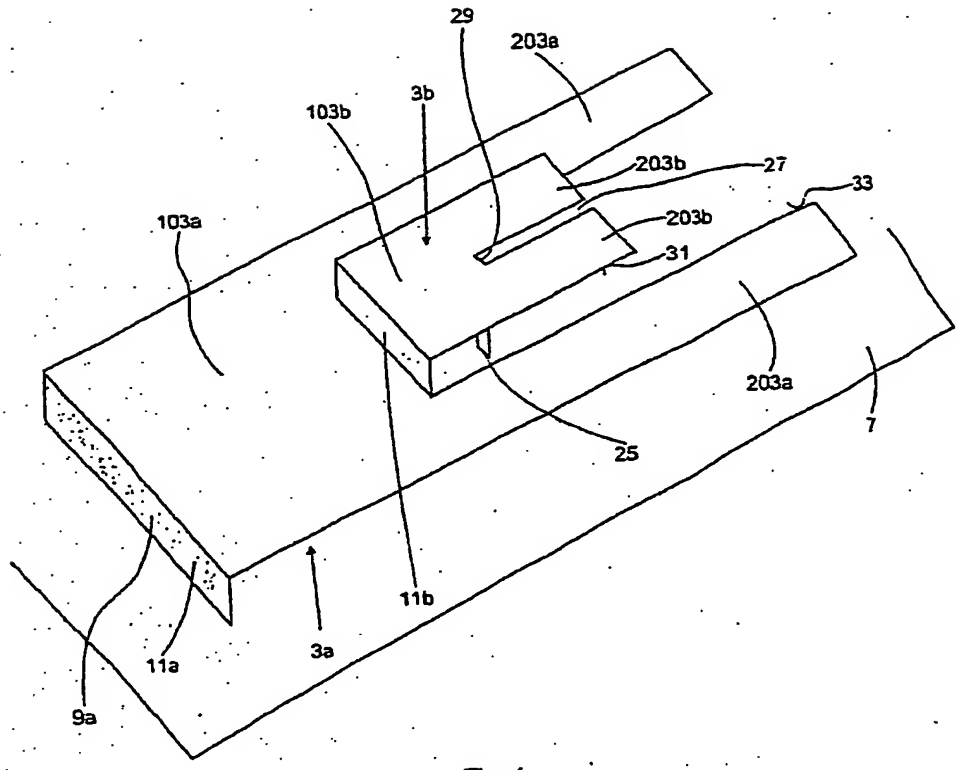
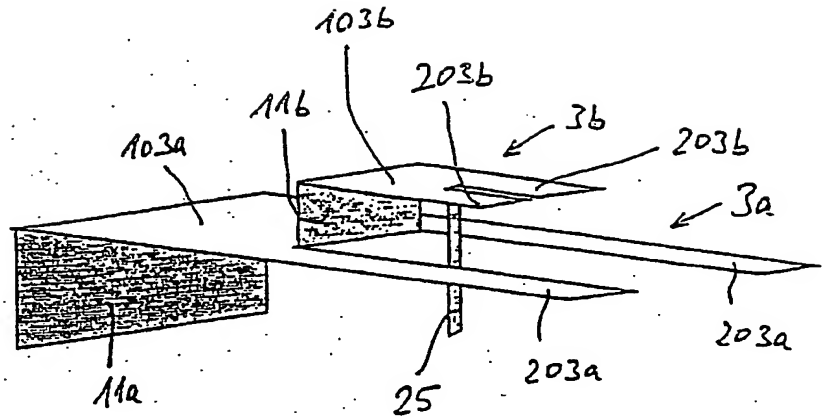


Fig. 1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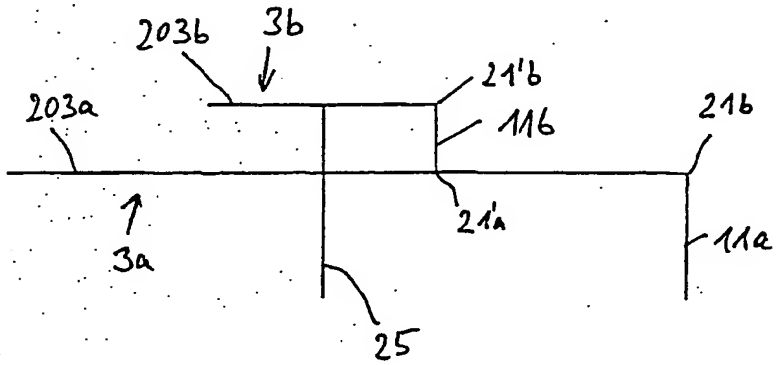
203b
103a
3a
203a
11a
25
203a

Fig. 2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203a
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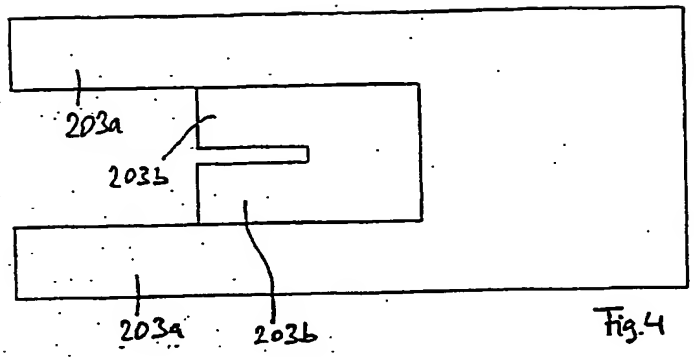
3a
11a
25

Fig. 3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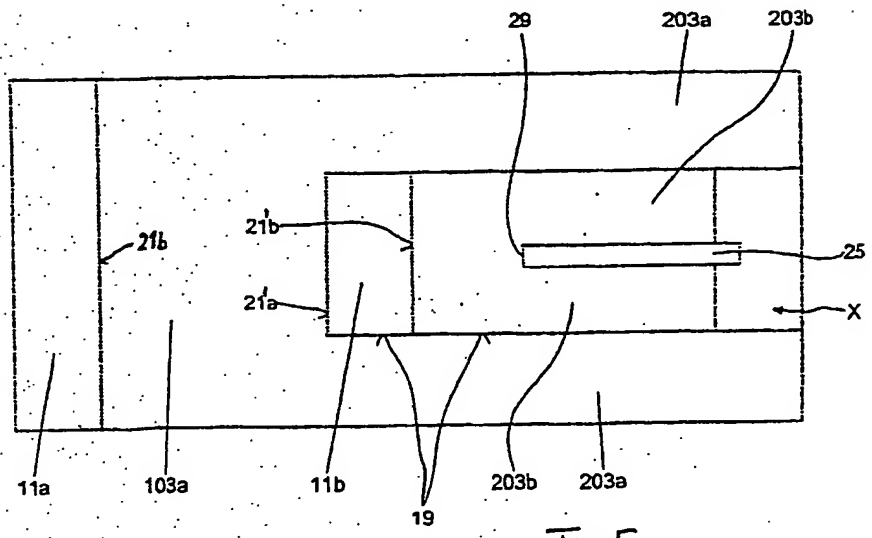
203b
203a
203b

Fig.4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25
X
11a
103a
11b
19
203b
203a

Fig. 5

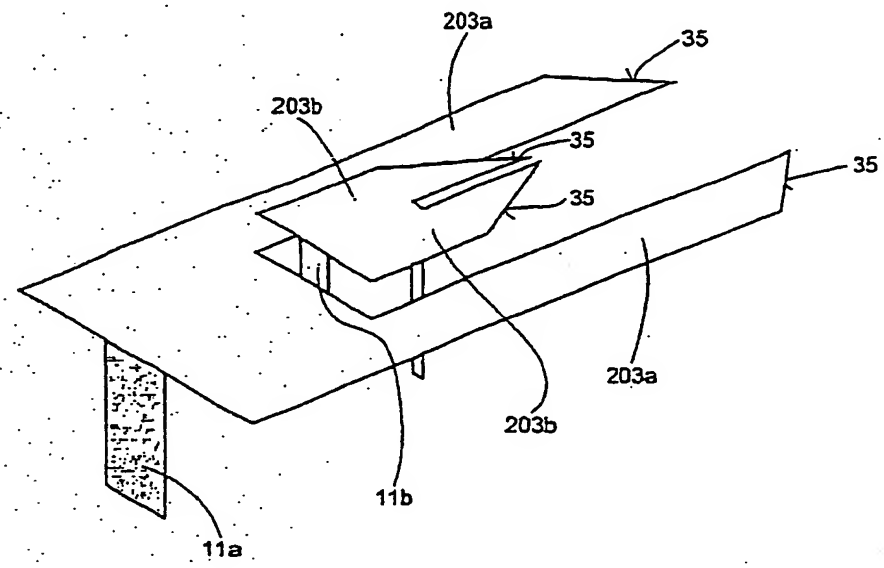


Fig. 6

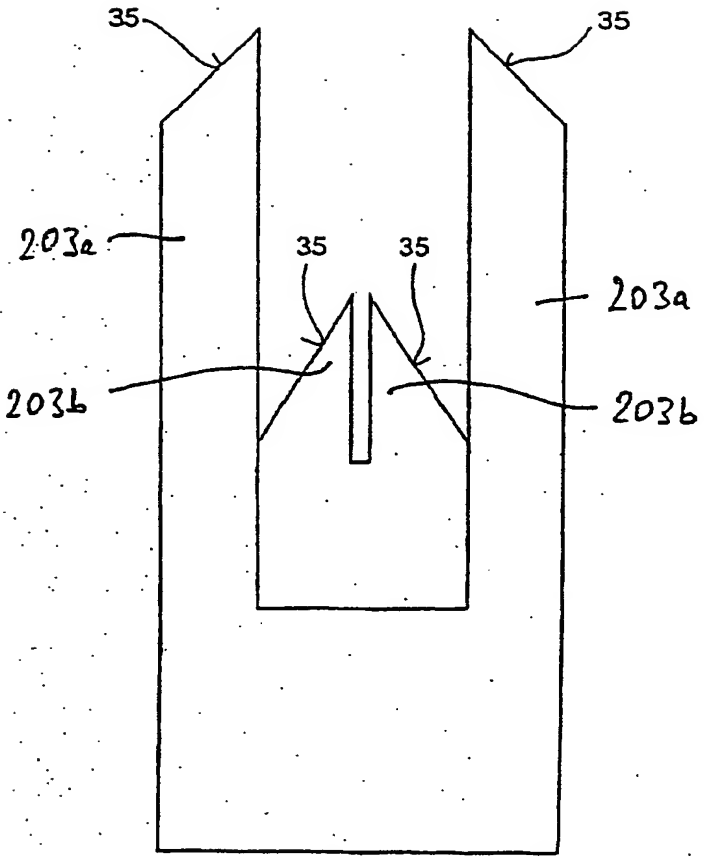


Fig. 7

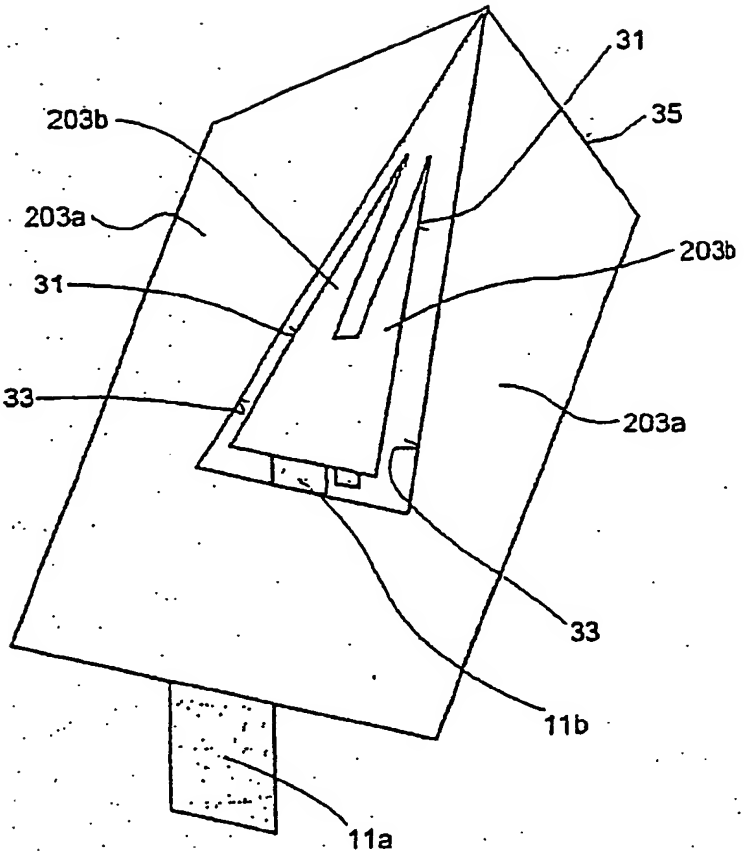


Fig. 8

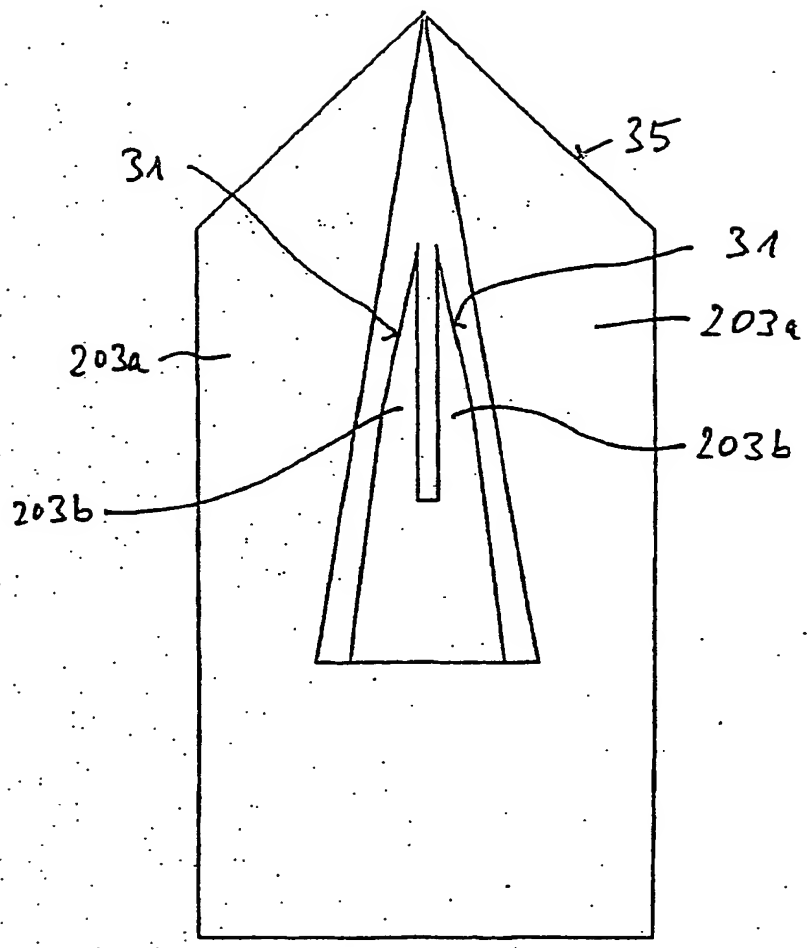


Fig. 9

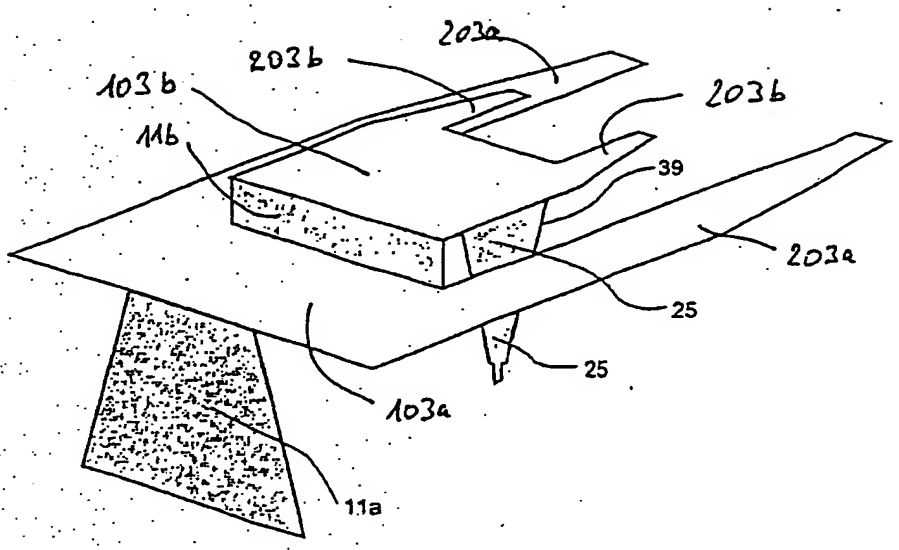


Fig. 10

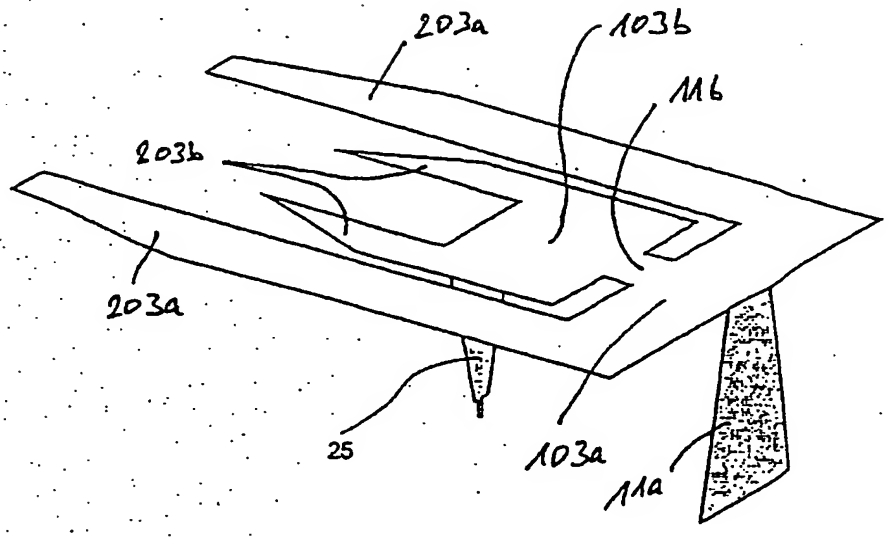


Fig. 11

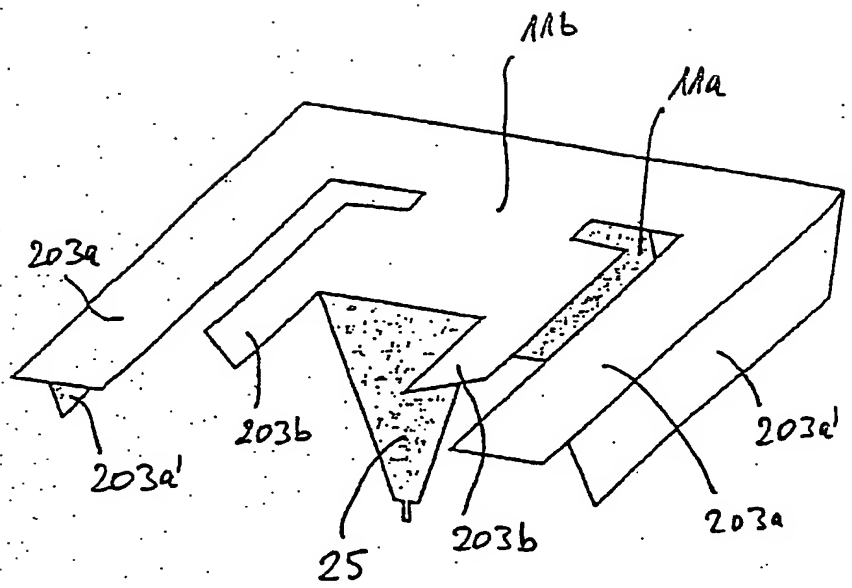


Fig. 12

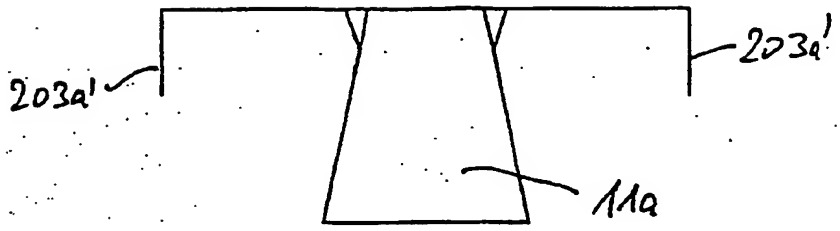
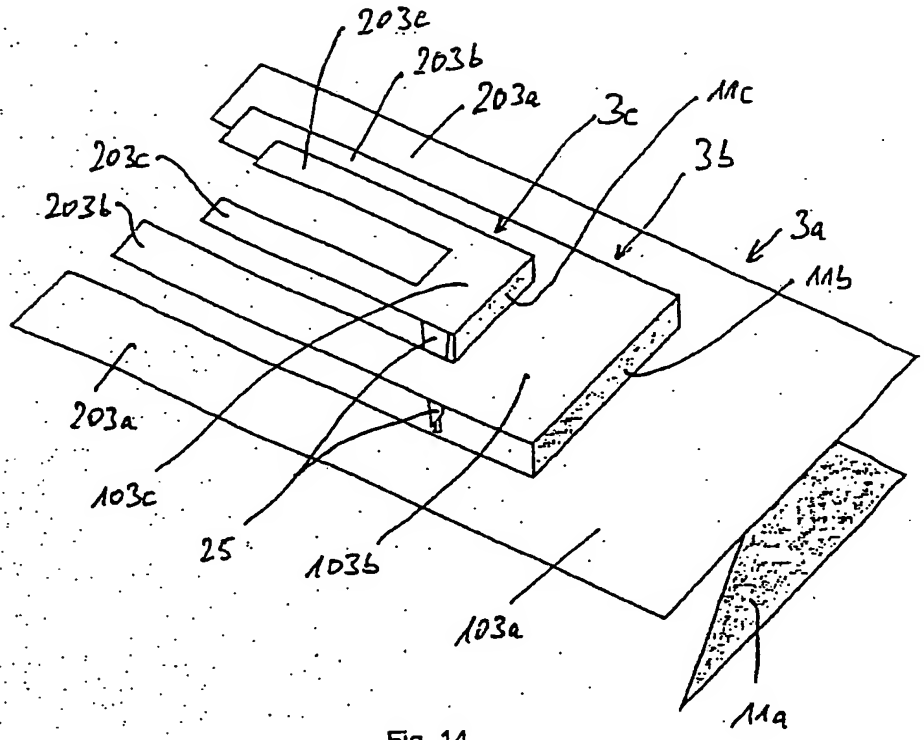


Fig. 13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203b
203a
3c
11c
3b
203c
203b
3a
11b
203a
103c
25
103b
103a
11a

Fig. 14

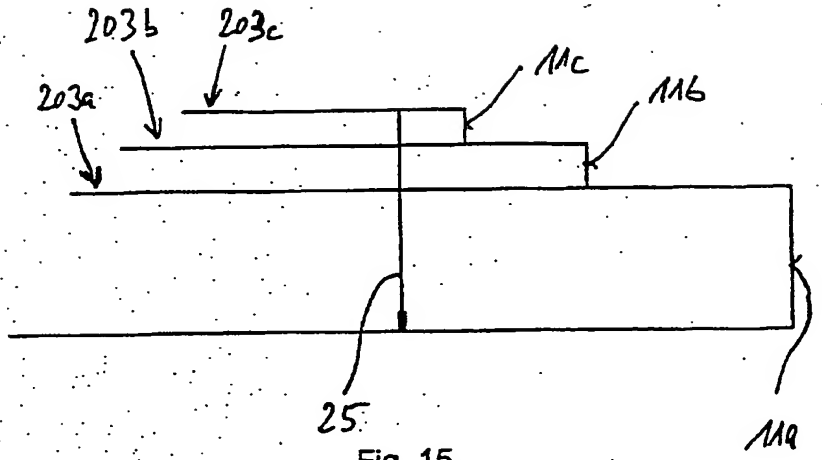

Fig. 15

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/06199

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01Q1/24 H01Q5/00 H01Q9/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 195 12 003 A (FRANCE TELECOM) 5 October 1995 (1995-10-05) figure 2 column 1, line 8 column 3, line 1 - line 34 column 3, line 50 - line 53	1-12,14, 15
X	US 5 977 916 A (HAUB DAVID RYAN ET AL) 2 November 1999 (1999-11-02) column 4, line 60 - line 65 column 5, line 1 - line 5 figure 6	13
A	RICHARD C. JOHNSON: "Antenna Engineering Handbook" 1993 , MCGRAW-HILL , NEW YORK, USA XP002256266 page 7-16 -page 7-18	1-15

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[X] Further documents are listed in the continuation of box C. [X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 October 2003	28/10/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Hirsch, S

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/06109

(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 310 586 B1 (TAKAHASHI TOSHIYUKI ET AL) 30 October 2001 (2001-10-30) figure 2	1
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PCT/EP 03/06199

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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP 03/06129

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 7 H01Q1/24 H01Q5/00 H01Q3/04

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

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IPK 7 H01Q

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Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
EPO-Internal, WPI Data

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	DE 195 12 003 A (FRANCE TELECOM) 5. Oktober 1995 (1995-10-05) Abbildung 2 Spalte 1, Zeile 8 Spalte 3, Zeile 1 - Zeile 34 Spalte 3, Zeile 50 - Zeile 53	1-12,14, 15
X	US 5 977 916 A (HAUB DAVID RYAN ET AL) 2. November 1999 (1999-11-02) Spalte 4, Zeile 60 - Zeile 65 Spalte 5, Zeile 1 - Zeile 5 Abbildung 6	13
A	RICHARD C. JOHNSON: "Antenna Engineering Handbook" 1993 , MCGRAW-HILL , NEW YORK, USA XP002256266 Seite 7-16 -Seite 7-18	1-15

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Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hirsch, S

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